

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

SALVATORE GITTO
AND PHYLLIS GITTO,

Plaintiffs,

vs.

A.W. CHESTERTON CO., INC.,
et al.,

Defendants.

Civil Action No. 07 CV 4771 (DC)

DECLARATION OF ROGER B. HORNE, JR.

I, Roger B. Horne, Jr., declare the following:

1. I am a retired Rear Admiral of the United States Navy, for which I served between 1956 and 1991.
2. I began my Navy career in 1956, immediately after receiving a Bachelor of Science degree in Naval Engineering from the United States Naval Academy in Annapolis, Maryland.
3. Throughout my Navy career, I concentrated in ship design, engineering, construction, overhaul and inspection, and ultimately achieved the rank of Chief Engineer and Deputy Commander, Naval Sea Systems Command ("NAVSEA") for Ship Design and Engineering. Prior to that, I served as Deputy Commander, NAVSEA for Facilities and Industrial Management; Commander, Puget Sound Naval Shipyard; Commander, Engineering Duty Officer School; Production and Repair Officer, Mare Island Naval Shipyard; and Nuclear Submarine Inspection Officer, Supervisor of Shipbuilding Office, Ingalls Shipyard.
4. Additionally, I served as a Visiting Professor in Naval Engineering at the University of Michigan. I also have received extensive post-graduate education in Naval

Engineering, including a Master of Science Degree in Mechanical Engineering from the U.S. Naval Postgraduate School.

5. In addition, I received recognition for achievements in the fields of Marine Machinery and Engineering. Specifically, I received three Navy Legion of Merit Awards and three Meritorious Service Awards for Engineering and Industrial Achievement, as well as an award from the Marine Machinery Association.

6. A true and correct copy of my current Curriculum Vitae is attached as Exhibit 1.

7. I am aware that a lawsuit has been filed against several Defendant corporations, including Eaton Hydraulics Inc., formerly known as Vickers, Incorporated ("EHI"), by Plaintiffs who allegedly were injured by Plaintiff Salvatore Gitto's exposure to asbestos and asbestos-containing products aboard certain Navy vessels at the Brooklyn Navy Yard from 1951 to 1952 and from 1954 to 1966. I understand that Plaintiff alleges exposure to and subsequent injuries from certain EHI pumps and valves aboard these Navy vessels. It is my understanding that Plaintiff also alleges that Defendant corporations, including EHI, failed to warn Plaintiff of the alleged hazards related to asbestos in such products.

8. Based on my thirty-five years of service in the U.S. Navy, as discussed above, I can attest to the level of direction, supervision, and control exercised by the Navy over all aspects of products installed on Navy vessels in the 1950s and 1960s, particularly the provision of warnings, labels, and other caution statements accompanying such equipment.

9. Specifically, through my various positions in the Navy, I have personal knowledge of the design, manufacture, and maintenance of products installed on U.S. Navy vessels. All products supplied for these Navy vessels, including pumps and valves manufactured by EHI, were manufactured in accordance with reasonably precise Navy specifications, and were reviewed and approved by the Navy at the vendor's plant and at the shipbuilding yards. In addition, any EHI products used on these Navy vessels conformed to the Navy specifications.

10. Having served as Chief Engineer and Deputy Commander for NAVSEA's Ship Design and Engineering Division, I was responsible to the Commander of NAVSEA for

developing ship designs and for overall technical support to the operating fleet, maintenance of ships, and ships under construction. Additionally, I was responsible for the maintenance of Navy ship military specifications and for monitoring compliance with the specifications by all vendors and contractors of Navy equipment.

11. With regard to any EHI pumps or valves installed aboard U.S. Navy vessels in the 1950s and 1960s, all aspects of the design performance requirements and materials for construction, including thermal insulation, were specified by the Secretary of the Navy or his delegates. Such Navy specifications prescribed the use of asbestos-containing insulation for products. In other words, if asbestos was in any pumps or valves supplied by EHI, it was prescribed explicitly by the Navy through such Navy specifications, and EHI could not unilaterally change or omit asbestos.

12. With respect to all warnings, including any asbestos warnings, the U.S. Navy had precise specifications as to the nature of any communications affixed to equipment supplied by EHI to the Navy. EHI would not have been permitted, under the detailed Navy specifications, associated regulations, and procedures, to affix any type of warning or caution statement regarding asbestos to the equipment intended for installation onto a Navy vessel, beyond those required by the Navy.

13. Attached as Exhibit 2 is an example of the Navy's detailed control and direction over the content of technical manuals for electrical and mechanical equipment, such as pumps or valves supplied by EHI and installed on Navy vessels. Exhibit 1 is a military specification, MIL-T-15071B (SHIPS), dated 18 Aug. 1954, detailing the Navy's explicit requirements regarding the contents of all technical manuals for electrical and mechanical equipment. This specification demonstrates that the Navy had final approval over all such technical manuals and that any warnings affixed to or accompanying equipment installed on Navy vessels were prescribed or proscribed by the Navy through, among other things, its review and approval of all technical manuals. For example, Section 3.4.7.1 mandates that "[p]rior to the printing of the final

manuals, a preliminary manual shall be prepared and submitted in duplicate to the bureau or agency concerned via the Government inspector for approval and assignment of a Navy NAVSHIPS identification number." In short, the Navy was intimately involved with and had final approval over all technical manuals, safety or hazard information, and all other written information that accompanied equipment installed on Navy vessels in the 1950s and 1960s. Any warnings regarding the dangers of asbestos were prescribed and proscribed by the U.S. Navy. Contractors such as EHI could not deviate with Navy-dictated warnings to comply with any state-law imposed warnings. In the 1950s and 1960s, the Navy knew there were no warnings regarding asbestos hazards accompanying products installed on Navy vessels, and had a contractor such as EHI unilaterally attempted to add such warnings, it would have been prohibited and proscribed from doing so.

I declare under penalty of perjury that the foregoing is true and correct.

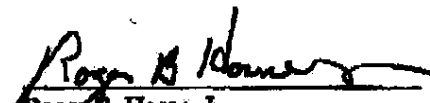

Roger B. Horne, Jr.

EXHIBIT 1

Roger B. Horne, Jr.
Rear Admiral, USN (Ret.)

Professional Competence

Design engineering, construction and operation of ships and ship systems. Shipyard operations including contract administration and major ship construction, overhaul and inspection. Industrial processes and inspection techniques related to shipyard and other major industrial work. Nuclear power plant design, construction, refueling, maintenance, and quality control. Development and interpretation of industrial specifications contract administration and financial management of large industrial projects.

Background and Professional Honors

B.S. (Naval Engineering), U.S. Naval Academy
M.S. (Mechanical Engineering), U.S. Naval Postgraduate School
M.B.A. (Executive), Golden Gate University
Shipyard Nuclear Shift Test Engineering School
Ship Construction School, Portsmouth Naval Shipyard
Dynamic Shock Analysis Course, Princeton
Navy Destroyer Engineering Course, Damage Control Course, and Fire Fighting Course
Qualified Naval Surface Ships and Submarines (Engineering Duty)
Recipient, Institute of Industrial Engineering Outstanding Achievement in Industrial Management Award
Recipient, Jack Flannigan award for Contributions to the Quality of Marine Machinery given by the Marine Machinery Association
Three Navy Legion of Merit awards and three Meritorious Service Awards for Engineering and Industrial Achievements
Patent for Timber Sterilization

Professional Profile

Principal Engineer and Head of the Marine and Aviation Practice Area.
Exponent, Failure Analysis Associates, Inc.
Visiting Professor,
Ship Construction, University of Michigan
Chief Engineer and Deputy Commander
Naval Sea Systems Command for Ship Design and Engineering
Deputy Commander
Naval Sea Systems Command for Facilities and Industrial Management
Commander,
Puget Sound Naval Shipyard
Commander,
Engineering Duty Officer's School
Production and Repair Officer,
Mare Island Naval Shipyard
Nuclear Engineering Manager,
Puget Sound Naval Shipyard
Nuclear Submarine Inspection Officer, Supervisor of Shipbuilding Office,
Ingalls Shipbuilding
Chief Engineer
USS OZBOURN DD 846
Past Member of the American Bureau of Shipping Technical Committee
Member, Society of Naval Engineers

Past Member Society of Naval Architects and Marine Engineers
Past member Society of Industrial Engineers
Past member American Bureau of Shipping

EXHIBIT 2

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(ORIG)
18 August 1954
~~SUPERSEDED~~
MIL-B-15071A(ORIG)
20 October 1955

MILITARY SPECIFICATION
TECHNICAL MANUALS FOR MECHANICAL,
AND ELECTRICAL EQUIPMENT

1. SCOPE

1.1 Scope - This specification covers technical manual requirements for electrical and mechanical equipment.

1.2 Classification - Technical manuals shall be of the following types as specified (see 6.1):

- Type A - (Type A manuals may be required where the system or equipment to be described is of a highly specialized or extremely complex nature, and where the importance of the equipment justifies unusual effort in the preparation of the manual.) (See 3.3.)
- Type B - (Type B manuals are required where the equipment or system to be described has no direct commercial counterpart or which is sufficiently complex that a detailed description, and maintenance instructions are required and must be supplemented by sufficient photographs, drawings, parts lists, etc.) (See 3.5.)
- Type C - (Type C manuals are required where the equipment or system to be described is an adaptation or variation of conventional commercial equipment, where with certain modifications and additional data, the type of instructional matter normally furnished will serve the purpose.) (See 3.6.)
- Type D - (Type D manuals are required where the equipment or system to be described is generally the same as equivalent commercial equipment, or is sufficiently simple that standard manufacturer's instruction pamphlets and service data are adequate.) (See 3.7.)

2. APPLICABLE DOCUMENTS

2.1 The following specifications and drawings, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

MILITARY

MIL-R-15137 - Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).

NAVY DEPARTMENT

General Specifications for Inspection of Material.

DO NOT REMOVE

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MIL-T-150712(SHIPS)

DRAWINGS

BUREAU OF SHIPS

S0103-73729 - Standard Drawing Format for Production Drawings Prepared by Contractor or Manufacturer for Approval by Government Agency.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Material - The minimum material requirements are as specified hereinafter. A good grade material shall be used when a definite material is not specified.

3.2 Distribution required - Distribution shall be as follows except when identical manuals have been previously distributed to all the addressees:

- (a) Two copies packed with each unit of equipment (for ultimate placement onboard ship) (see 3.4.6).
- (b) Four copies to the Bureau of Ships.
- (c) Two copies to the cognizant Supervisor of Shipbuilding.
- (d) One copy to the cognizant Inspector of Naval Material.
- (e) One copy to the Director, Naval Engineering Experiment Station, Annapolis, Maryland (propulsion machinery and major auxiliary equipment only).
- (f) One copy to the Superintendent, U.S. Naval Academy, Postgraduate School, Monterey, California, (propulsion units and major auxiliary equipment only).
- (g) Two copies to each U.S. Naval Shipyard (except Portsmouth, N.H. - for Military equipment only).
- (h) Two copies to each U.S. Naval Shipyard concerned (for non-Military equipment only).
- (i) Two copies to Portsmouth Naval Shipyard (Submarine equipment only).
- (j) One copy to the Submarine Supply Office, Philadelphia, Pa. (Submarine equipment only).
- (k) Two copies to all Submarine Tenders (Submarine equipment only).
- (l) Six copies to the Commander, Submarine Base, New London, Conn. (Submarine equipment only).

(m) Manuals for stock shall be specified generally in the following quantities:

<u>Number of equipments</u>	<u>Number of copies</u>
1 to 25	10 plus 2 per equipment
26 to 950	50 plus 2 per equipment
Over 950	100 plus 2 per equipment

Bulk copies of manuals furnished for stock shall be shipped to:

Commanding Officer
Naval Supply Depot
Mechanicsburg, Pennsylvania
"For SPCC stock"

- (n) In addition to (a) through (m) above, the shipbuilder shall provide technical manuals for selected components and systems in the following minimum quantities to the Fitting Out Activity for placement onboard the ship:

	<u>Heavy cruisers and larger type ships</u>	<u>Smaller ships</u>	<u>Small craft and submarines</u>
Engineering piping systems	50	25	5
Propulsion prime movers	10	5	1
Propulsion reduction gears	10	5	1
Boilers, main	10	5	1

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

	Heavy cruisers and larger type ships	Smaller ships	Small craft and submarines
Diesel generator sets	10	5	1
Distilling plants	10	5	1
Refrigeration plants	10	5	1
Gasoline handling systems	10	5	1
Submarine electrical propul- sion equipment	--	--	1
Ships service switchboards and motor generator sets	--	--	1
Main storage batteries	--	--	1

3.2.1 For ships constructed under the Mutual Defense Assistance Program only, the requirements of 3.2 (a) through (m) do not apply. Manuals for equipment and systems peculiar to ships constructed under the Mutual Defense Assistance Program shall be distributed as follows:

- (a) Six copies to the Military Assistance Advisory Group of each foreign Government assigned a ship of the class.
- (b) One copy to the Washington, D. C. Naval Attache of the recipient Government.
- (c) Four copies to the Bureau of Ships.
- (d) One copy to the cognizant Supervisor of Shipbuilding.
- (e) Two copies with each unit of equipment for placement onboard ship (see 3.4.6).
- (f) One copy to the cognizant Inspector of Naval Material.
- (g) Twelve copies to the Naval Supply Depot, Mechanicsburg, Pennsylvania.

Note. - Military equipment is defined as the auxiliary machinery necessary for the operation, maneuverability and combatant efficiency of the vessel.
Nonmilitary equipment is defined as ranges, coffee making apparatus, food mixing machines, sterilizers, laundry machines, sewing machines, refrigerators.

3.3 Type A manuals. - Type A manuals shall be as specified in the individual contract or order.

3.4 General requirements for types B, C, and D manuals. -

3.4.1 Identification. - All manuals shall be identified by a Navy identification number of the form "NAVSHIPS 000-0000" (see figures 1 and 2). This number will be assigned by the bureau or agency concerned upon a receipt of a preliminary copy submitted for bureau or agency approval. In urgent cases, this number may be obtained by a written request, containing complete descriptive data of the equipment. This number shall be imprinted on the upper left-hand corner of the cover, and the upper right-hand corner of the fly-leaf of all manuals prior to distribution.

3.4.2 Reproduction copy. - If offset negatives are used in the publication of the technical manuals, a complete set of such negatives shall, after completion of the manuals, be delivered to the Naval Supply Depot, Mechanicsburg, Pennsylvania and shall remain the property of the Government for use in subsequent reproduction of the manuals. Regardless of the method of printing used, one glossy print or negative of each half-tone illustration included in the manuals, shall be delivered to the Naval Supply Depot, Mechanicsburg, Pennsylvania, and shall remain the property of the Government for use in subsequent reproduction of the manuals. This requirement does not apply to type D manuals (3.7) nor to manuals for which reproduction copy has been previously furnished.

3.4.3 Copyright. - Technical manuals shall not be copyrighted. The bureau or agency concerned reserves the right to reproduce or have reproduced in part or in entirety all manuals procured under this specification.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

3.4.4 Security classification. - Unless otherwise specified in the contract or order, manuals shall be unclassified. If classified, notification of the classification shall appear on the front and back covers and each page of the manuals as shown on figures 1 to 5, inclusive. In addition, classified manuals shall have the following paragraph printed on the title page as shown on figure 2:

"WARNING: This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."

Classified manuals shall be marked with consecutive serial numbers beginning with number 1. Receipt cards shall be provided in all classified manuals. Each card shall contain the serial number of the manual in which it is included.

3.4.5 Revision to incorporate changes. - New, revised, or supplementary pages shall be furnished until the guarantee period expires. The quantity of pages furnished and the distribution shall be the same as for the manual provided in the original contract or order.

3.4.5.1 New pages. - When it is found necessary to include new information to augment the manual data, new pages shall be issued. These pages shall be identified with the following legend placed in the bottom outside corner, beside the page number and toward the binding edge of each page; on the first line, the word "New" followed by the NAVSHIPS identification number, and on the second line the month and year of issue. New pages shall bear the same number as the manual page they follow with the addition of a letter; for example, original page 69, new pages 69a and 69b. A reproduction copy of each new page shall be provided.

3.4.5.2 Revised pages. - If it is determined that information originally furnished in manuals must be changed for clarification, correction, or because every equipment covered by the manual has been uniformly modified, revised pages shall be issued. These pages shall be identified with the following legend placed in the bottom outside corner, beside the page number and toward the binding edge of each page; on the first line, the word "Revised" followed by the NAVSHIPS identification number, and on the second line the month and year of issue. Revised pages shall bear the same number as the page they replace. A reproduction copy of each revised page shall be provided.

3.4.5.3 Supplementary pages. - In instances where modifications are made only to a certain number of the total number of equipments covered by the manual, resulting in the need for alternate instructions to cover those items modified, this information shall be issued in the form of supplementary pages. These pages shall be identified with the following legend placed in the bottom outside corner, beside the page number and toward the binding edge of each page; on the first line, the word "Supplementary" followed by the NAVSHIPS identification number on succeeding lines the hull numbers of the specific ships to which the page applies, and on the last line the month and year of issue. Supplementary pages shall bear the same number as the manual page they follow with the addition of a letter; for example, original page 69, supplementary pages 69a, 69b. A reproduction of each supplementary copy shall be provided.

3.4.6 Time of delivery. - Two copies of the manuals shall be delivered with the first unit and each succeeding unit of equipment shipped except that no more than ten manuals for heavy cruisers and larger and no more than six manuals for smaller ships shall be considered necessary to fulfill this requirement when it is known the equipment is destined for a particular ship (see 3.2 for specific exceptions). If final manuals are not available at the time of delivery of the equipment, two copies of an adequate preliminary manual (see 3.4.7) shall be furnished to the Government inspector to fulfill the above requirements for shipment of manuals for each unit.

NOTE: The importance of delivering these manuals with each unit of equipment cannot be too strongly emphasized, since they are of great value in the installation of the equipment and in training and indoctrinating the ship's crew.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071D (SHIPS)

3.4.7 Preliminary manuals. -

3.4.7.1 Method of approval. - Prior to the printing of the final manuals, a preliminary manual shall be prepared and submitted in duplicate to the bureau or agency concerned via the Government Inspector for approval and assignment of a Navy NAVSHIPS identification number. Every effort shall be made to submit the preliminary manual in ample time to permit approval and final printing prior to the delivery date of the equipment. Preliminary manuals shall be furnished in instances where final manuals are not available for delivery with the equipment. In all instances where preliminary manuals are furnished in lieu of final manuals, they shall be replaced with final manuals within 60 days (see 3.4.6 and 3.4.7.2.3).

3.4.7.2 Contents. -

3.4.7.2.1 Text. - Preliminary manuals shall consist of a complete text of the instructions required for the type of manual to be furnished.

3.4.7.2.2 Illustrations. - Preliminary manuals shall contain a list of all illustrations, (photographs, exploded views, drawings, and sketches) and sample art work (less photos and drawings but including all exploded views and sketches) which will appear in the final manuals. If the final manual is to include test data, or a table of weights, for example, and if any or all of the items are not available when the preliminary manual is issued, then a foreword shall list all items which have been omitted and which will appear in the final manual.

3.4.7.2.3 Manual identification. - In all instances where preliminary manuals are furnished in lieu of final manuals, the NAVSHIPS identification number shall be stamped on all copies of the preliminary manuals prior to distribution (see 3.4.1).

3.4.7.2.4 Covers. - Covers for preliminary manuals shall be at least 20 by 26-65/500-basis gray antique finish cover stock or similar material, bellows fold, with the title and other pertinent information on the cover. This information shall be identical with that which will appear on the final manual except that the word "preliminary" shall appear directly in front of the identification number (see 3.4.1).

3.4.7.2.5 Printing. - The text may be printed by any quick, economical method, such as multigraph, mimeograph or similar method.

3.5 Type B manuals. -

3.5.1 Contents. - Type B manuals shall contain the following information as applicable, presented in a logical arrangement (see figures 1 to 9, inclusive):

- (a) Title page (see figure 2).
- (b) General data (see 3.5.1.1).
- (c) Table of contents, listing all divisions and primary and secondary subdivisions (such as chapters, sections) with the corresponding page numbers.
- (d) List of illustrations and drawings, specifying titles, figure numbers and pages on which such illustrations appear.
- (e) Introduction (see 3.5.1.2).
- (f) Detailed description (see 3.5.1.3).
- (g) Installation instructions (see 3.5.1.4).
- (h) Adjustments and tests (see 3.5.1.5).
- (i) Principles of operations (see 3.5.1.6).
- (j) Operating instructions (see 3.5.1.7).
- (k) Maintenance (see 3.5.1.8).

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

- (i) Parts Identification (see 3.5.1.9).
- (m) Drawings (see 3.5.1.10 and 3.5.2.4.5.4).
- (n) Memorandum pages (see 3.5.1.11).

Note. - Although these requirements are directly applicable to manuals covering specific equipment, they shall be followed as closely as possible for manuals covering systems, such as engineering piping systems. When a manual covers a system or an equipment composed of several distinct units (for example, a generating set consisting of a Diesel engine, a generator, a voltage regulator, and a controller), it may be desirable to arrange the manual in major divisions, each covering one unit. If so, the major divisions may be arranged by subdivisions, each corresponding to the requirements herein.

3.5.1.1 General data. - This division shall contain data such as the following:

- (a) Safety notice (where high voltages or special hazards are involved) (see figure 6).
- (b) Component list containing:
 - Description of item.
 - Navy type designation.
 - Standard Navy stock number.
 - Dimensions.
 - Weight (with or without packing).
- (c) Input power requirements and heat dissipation.
- (d) Salient design characteristics.
- (e) Electron tube complement.
- (f) Serial number (if appropriate).

3.5.1.2 Introduction. - This division shall include a general description of the equipment; explain briefly what it is, where it is used, and what it will do, also all information of a general character applicable to the complete equipment. When the text contains technical terms or terms not commonly used, definitions shall be included.

3.5.1.3 Detail description. - This division shall contain a complete detailed description of component assemblies and accessories which comprise the complete equipment; for example, in the case of a ship's service turbine generator set, the turbine, the gear, the generator, the exciter, and the voltage regulator. Allowable clearances, temperatures or tolerances shall be shown in tabular form.

3.5.1.4 Installation instructions. - This division shall contain methods of installation, alignment, precautions, mounting instructions, recommendations regarding shielding, grounding or bonding.

3.5.1.5 Adjustment and tests. - This division shall contain instructions for the adjustment and test of the system and its major components upon initial installation or under other conditions such as after major overhaul where complete system readjustment may be required.

3.5.1.6 Principles of operation. - This division shall contain a brief resume of the principles of operation together with such illustrations, sketches, schematic piping diagrams and schematic wiring diagrams to convey an understanding of the function and operation of the equipment. Descriptions of components and assemblies using electron tubes should provide an explanation of the electronic circuits. A preferred method of describing electronic circuits is to present the description in sections, such as amplifier features, power circuits, main audio transmission path and mechanical arrangements. Theory of operation should be included where unusual or unconventional circuits or techniques are involved.

3.5.1.7 Operating instructions. - This division shall contain simple, brief and effective instructions, including normal routines and precautions such as maximum and minimum loads, normal temperature or pressure limits, to be observed in starting, operating and shutting-down the equipment. Where operations are to be performed in specific sequence, step-by-step procedures shall be used. Operations shall be numbered in the order in which they are to be performed. Operating data which is frequently referred to in operating the equipment shall be included in this division. Tables and charts shall be used for the presentation of these instructions where varying operating conditions are encountered.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

3.5.1.8 Maintenance instructions. -

3.5.1.8.1 Preventative maintenance. - This division shall cover all maintenance procedures, inspection and routine adjustments which should be performed periodically and regularly for the purpose of preventing failure or impairment of equipment. Included in this division shall be routine maintenance check charts containing the following:

- (a) A tabulation of periodic routine mechanical and electrical tests and checks which should be accomplished regularly to insure continuity of service at peak performance.
- (b) Arrangement of the table shall be such as to indicate what is to be done, when it is to be done and how to do it.
- (c) Emphasis shall be placed upon the test facilities which may be incorporated in the various components.
- (d) Instructions shall be provided for the care, inspection and cleaning of all pertinent parts.
- (e) Instructions on lubrication shall be provided as applicable, preferably in chart form. They shall include information regarding lubrication recommended by the manufacturer, the type of lubricant to be used, together with specific time periods. Lubricants shall be described by Military specification numbers where applicable and by commercial designations.
- (f) Instructions shall be included stressing the importance of properly maintaining any safety devices, interlocks, provided to prevent damage to equipment or injury to personnel.

3.5.1.8.2 Corrective maintenance. - This division shall cover all information necessary to permit a technician to locate trouble and to make repairs or adjustments to each component, assembly or sub-assembly of the equipment. Included in this division shall be the following:

- (a) Trouble shooting guides for the localization of faults giving possible sources of trouble, the symptoms, probable cause, and instructions for remedying the faults.
- (b) Complete instructions on signal tracing for electric and electronic circuits, use of test instruments and other common servicing techniques.
- (c) Ample illustrations, photographs, exploded views giving details of mechanical assemblies, and simplified schematic diagram of the electric circuits. Illustrations contained in other divisions may be used and referred to under this division without duplicating them.
- (d) Voltage and resistance diagrams or tables for each electronic assembly showing normal voltages (with and without audio signal) and resistances as measured at the terminals of each tube socket and at other significant points in the circuit.

3.5.1.9 Parts identification. - This division shall contain identification data covering all repair parts (parts and assemblies which are wearable or expendable during normal repair) to facilitate ready identification of parts for replacement and ordering purposes. This data shall be presented in one of the three following alternate arrangements:

- (a) **Parts list and illustrations. -** Where the manual does not include reduced size drawings which are prepared in accordance with the standard drawing format shown on Drawing S0108-73728, listing all repair parts, the parts identification shall be in the form of a parts list with illustrations, arranged as specified in 3.5.1.9.1 and 3.5.1.9.2.
- (b) **Drawings and illustrations. -** Where the manual includes reduced size drawings which are prepared in accordance with the standard drawing format shown on Drawing S0108-73728 (see figure 5) listing all repair parts, and where only mechanical parts are involved, the parts identification shall be in the form of illustrations to supplement the lists of material on the drawings. Illustrations shall be prepared for each assembly, subassembly and their component repair parts in accordance with 3.5.1.9.2 except that the index numbers shall be identical with the piece numbers assigned on the above drawings. Appropriate notes shall be added to these illustrations referring to the drawings on which the assigned numbers are listed.

7

2

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-150713(SHIPS)

- (c) Drawings, illustrations and functional listing. - Where the manual includes reduced size drawings which are prepared in accordance with the standard drawing format shown on Drawing SO103-73729, and which list all repair parts, and where electrical or electronic parts are involved, the parts identification shall be in the form of a functional listing of electrical and electronic parts with illustrations to supplement both the functional listing and the list of materials on the drawings. The functional listing of all electrical and electronic parts shall be prepared in accordance with 3.5.1.9.1.3.2. Illustrations shall be prepared for each assembly, subassembly and the component repair parts thereof in accordance with 3.5.1.9.2, except that the index numbers shall be identical with the piece numbers assigned on the above drawings (for mechanical parts) and with the reference designation assigned on the schematic wiring diagram (for electrical or electronic parts) appropriate notes shall be added to these illustrations referring to the drawings on which the assigned numbers are listed.

3.5.1.9.1 Parts list. -

3.5.1.9.1.1 Contents. - The parts list shall contain the following information:

- (a) List of illustrations by figure and page number.
- (b) Introduction.
- (c) Parts tabulation.
- (d) Special tools.
- (e) Numerical index of part numbers.

3.5.1.9.1.2 Introduction. - This division shall contain sufficient instructions to explain the following:

- (a) Any symbols used therein.
- (b) The general system of group assemblies in relation to the complete article.
- (c) All cross-index systems employed.
- (d) Titles or other markings intended to segregate different models.
- (e) Other information as may be required to facilitate rapid and accurate use of the parts list.

3.5.1.9.1.3 Parts tabulation. - The parts tabulation shall contain the following information:

3.5.1.9.1.3.1 Tabulation for mechanical parts. -

- (a) Figure number. This shall denote the illustration number wherein the part has been shown.
- (b) Index number. This shall denote the index number covering the complete main or subassembly as listed in the catalog.
- (c) Name of part and brief description.
- (d) Number required.
- (e) Unit of issue.
- (f) Contractor's service part number.
- (g) Actual manufacturer's name.
- (h) Actual manufacturer's service part number.
- (i) Standard Navy stock number assigned in accordance with specification MIL-R-15137.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

3.5.1.9.1.3.2 Tabulation for electrical and electronic parts. -

- (a) Figure number. This shall denote the illustration number wherein the part has been shown.
- (b) Reference designation assigned in the schematic wiring diagram.
- (c) Name of part and brief description (including electrical ratings).
- (d) Function. The function shall consist of a brief statement of use, purpose or the function of the part in the component.
- (e) Military type number (where applicable).
- (f) Actual manufacturer's name.
- (g) Actual manufacturer's service part number.
- (h) Standard Navy Stock Number assigned in accordance with Specification MIL-R-15137.

3.5.1.9.1.4 Special tools. - This division shall contain a list of all special tools supplied with the equipment showing the quantity, unit of issue (each, pair, set), description, and manufacturer's identification number.

3.5.1.9.1.6 Numerical index of part numbers. - This index shall list all items contained in the parts tabulation, arranged in a logical numerical sequence. These items shall be so arranged that column 1 of the index will give the manufacturer's part number and column 2 will give the illustration index number or numbers in which the part appears.

3.5.1.9.2 Illustrations. - A view of each assembly, subassembly and the component parts thereof shall be shown. Identification of illustrated parts with the listed parts shall be facilitated by the use of key or index numbers which will identify all the parts in the group assembly listing.

3.5.1.9.2.1 Illustrations of the exploded type may be used. When the use of exploded views is not practical, simple cross-sectional views may be used. The cross-sectional drawings when used for this purpose preferably shall be approved drawings or excerpts from approved drawings, and shall show both the manufacturer's drawing number and the drawing number of the bureau or agency concerned. In case no applicable approved drawing is available, cross-sectional views from manufacturer's drawings may be used.

3.5.1.9.2.2 A figure number and proper identifying caption shall appear with each illustration. In the case of subassemblies or sub-assemblies, the caption shall also identify and give the index number of the complete assembly as it appears in the parts tabulation.

3.5.1.9.2.3 An index number with an arrow to the item, part, or tool to which it pertains shall be used in illustrations. In cases where an assembly is exploded into its component parts, one or more of which require further explosion, the primary explosion shall be referenced by the use of numerals only. The subassembly shall be referenced by the basic number of the part as it appears in the primary assembly but each exploded part shall have an alphabetical designation, suffixed to the number of the primary part. The sequence of numerical and alphabetical designations shall correspond to the order of removal upon disassembly, wherever practicable.

3.5.1.9.2.4 Index numbers and arrows shall be used on each illustration to identify repair parts only.

3.5.1.10 Drawings. - This division shall contain reproductions of approved drawings, additional block diagrams, exploded views or explanatory drawings, as necessary to supplement the descriptive matter contained in the text. Wherever feasible, such diagrams, exploded views and sketches should be inserted in the text as close as possible to that portion of the text to which they apply. Diagrams of switches and relays used in the system, showing the terminal numbering shall be inserted as additional drawings. The standard color codes for resistors and capacitors shall be stated, where applicable.

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MIL-T-15071B(SHIPS)

3.5.1.11 Memorandum pages. - Five blank pages shall be inserted at the end of the manual for memorandum purposes.

3.5.2 Format. -

3.5.2.1 Divisions (chapters or sections). - Divisions of manuals shall be by chapters or sections, numbered or lettered consecutively. In general, chapters shall be the main divisions of larger manuals and sections shall be the main division of smaller manuals. Chapters shall be further divided into sections which shall be numbered or lettered consecutively within the chapter. Where chapters are used, the first page of each chapter shall be arranged as shown on figure 3.

3.5.2.2 Page identification and numbering. -

3.5.2.2.1 At the top of each left-hand page, flush with the outside margin, shall appear a briefed title of the manual. At the top of each right-hand page, flush with the outside margin, shall appear the division, chapter or section number followed by its title. In some cases, it may be necessary to brief the title.

3.5.2.2.2 With the exception of fold-over pages and as otherwise specified herein, pages of the manuals shall be numbered consecutively in the bottom outside corner of each page, using Arabic numerals. The first page of chapter 1 or section 1 shall be page 1. All odd-numbered pages shall appear as right-hand pages. Fold-over pages shall be right-hand pages, and when they are used within the text they shall be assigned two page numbers, and the numbers shall be printed on the face of the sheet. Fold-over pages shall be arranged so that page numbers are visible without unfolding. Fold-over arrangements are shown on figure 5.

3.5.2.2.3 In manuals arranged for a system or equipment composed of several distinct units (see note under 3.5.1) the pages may be consecutively numbered within each chapter (or section), the first page of each chapter (or section) being page 1. In this case, the page number shall also include the chapter number. The chapter number shall appear first.

3.5.2.3 Layout treatment. - The layout of the manuals shall be such as to conserve space without detracting from the usability or clarity of material presented. Blank pages and spaces shall be avoided wherever possible except as specified in 3.5.1.11. Textual material shall be printed on both sides of the page. Illustrations serving no instructional function or to which no reference is made in the text shall not be used. Partial page illustrations within the text are highly desirable. Several small illustrations may be grouped to form a single page layout. Wherever possible, illustrations shall be located so that reference can be made from applicable text without turning a page. Fold-over pages, double, or triple pages will be permitted only for illustrations where this procedure is essential to insure legibility. Fold-over pages shall be used primarily in the back of the manual for the purpose of reproducing the drawings. Whenever it is desirable to include fold-over pages with the text in the front of the manual, such fold-over pages shall not be backed up with text or illustrations. All drawings which will be used for reference purposes while reading the text shall be provided with a blank section of the same size as a page at the left hand edge of the drawing (see figure 5). This will permit the drawing to be withdrawn clear of the manual while the text is being studied. Drawings shall be reproduced on a page the same height as other pages in the manual, in order that all folds will be parallel to the bound edge of the manual.

3.5.2.4 Text. -

3.5.2.4.1 Tables and charts. - The use of tables and charts is desirable. Such tables and charts shall not be elaborate or complicated, and sufficient explanation shall be given to make them easily understood.

3.5.2.4.2 Reference to figures. - Where reference is made to figures, the reference shall be to the figure number. The page number shall not be used except when the illustration is located more than three pages away from the reference. When reference is made to items shown on figures by index numbers, figure number and index number shall be indicated as follows: "Remote nut (7) and drive out bolt (8) (see figure 20).

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MIL-T-150710(SEIPS)

3.5.2.4.3 Numbers. - Numbers from one to nine, inclusive, appearing in the text for the purpose of stating quantities shall be spelled out. All other numbers shall be shown as numerals except when they are used at the beginning of a sentence, in which case they shall be spelled out and followed by the numeral in parenthesis.

3.5.2.4.4 Reference to materials. - All materials required for maintenance referred to in the manual, such as lubricants, sealing materials or abrasives, shall be described by Military specification numbers where applicable.

3.5.2.4.5 Illustrations. - Illustrations (including photographs, exploded views, drawings and sketches) shall be well planned and executed. They shall enable immediate and thorough comprehension of the subject.

3.5.2.4.5.1 Illustration identification. - Illustrations shall be identified by figure number and a title. Identifying figure numbers and titles shall be positioned immediately beneath the illustration. Whenever reduced size reproductions of drawings are used as illustrations, the drawing number shall be shown as well as the figure number.

3.5.2.4.5.2 Photographs. - Photographic illustrations shall be prepared with equipment capable of reproducing all details and shall show clearly the subject matter. Photographs shall be uniformly retouched to define shapes, accentuate details, and establish correct tone value of sufficient contrast for photolithographic reproduction.

3.5.2.4.5.3 Exploded views. - Exploded views may be used for showing the component parts of a subject. Well retouched photographs in which sharp contrast is incorporated to insure distinct detailed separation of parts may also be used for this purpose. It is preferable that all parts be exploded on their functional axis.

3.5.2.4.5.4 Drawings. - When drawings are necessary to illustrate the description, operation, and maintenance of the equipment or system, they shall be reduced in size as necessary (see figure 5), and reproduced in black and white. Each drawing shall be identified with the drawing number of the manufacturer and the bureau or agency concerned. Drawings shall be bound into the manual as shown on figure 5 (see also 3.5.2.3). Drawings shall normally be placed in the back of the manual but they must be inserted close to the references when practicable. Care shall be taken in the preparation of drawings for reproduction in the manual to insure that when the drawings are reduced in size they shall be clear and legible.

3.5.2.4.5.5 Sketches (see figure 6). - (NOTE: This paragraph does not pertain to reduced-size reproduction of standard approved drawings nor to portions of these drawings which may be extracted and used as illustrations in a manual.)

3.5.2.4.5.5.1 The rendering of sketches (airbrushing or line rendering) shall be done with the highest possible contrast. Adjoining areas of an illustration having similar values are to be avoided. Edges of all silhouette half-tone illustrations shall be sharply defined by retouching.

3.5.2.4.5.5.2 Exploded views and cutaway views shall be drawn in perspective to appear as realistic as possible without distortion. Isometric views may be used for small parts or units which lend themselves to this method without showing noticeable distortion.

3.5.2.4.5.5.3 Except for diagrams, schematics, orthographic projections, reproduction of approved drawings, all line sketches shall be prepared with the use of shading mediums to clarify and model the forms of the sketch. This rendering shall be kept as simple as possible. Fuzzy freehand lines, rendering with fine lines, and cross hatching shall be avoided. Solid black shall be used in dark areas to increase contrast and simplify the sketch. This applies to cutaway views, exploded views and cross-section views.

3.5.2.4.5.6 Color. - Color shall be used functionally where necessary to show electric circuits, the flow of materials, schematic diagrams or operational diagrams. Unessential color shall not be used. Backgrounds of color tints may be used to clarify outline sketches, but color for decoration is not desired.

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MIL-T-15071B(SHIPS)

3.5.2.4.6 Indexing and referencing of illustrations.

3.5.2.4.6.1 Significant features or components of illustrations shall be identified by brief applicable nomenclature with arrows. Index numbers may be used on illustrations with explanatory legend under the sketch or photo only when an extremely large amount of nomenclature is required.

3.5.2.4.6.2 In order to assure a clear definition of lines where they pass through light and dark areas, arrows (leaders) shall be drawn in black with one edge outlined in white. The arrowhead, however, shall be completely outlined in white. The thickness of arrows shall be uniform and no greater than necessary to indicate clearly the desired details.

3.5.2.4.6.3 Index references and letterings (nomenclature) shall be planned to reproduce uniformly a size not less than 10-point type. Where index numbers are used, each illustration shall be handled independently with index numbers assigned consecutively, starting with number 1, except as specified in 3.5.1.9 (b), (c) and 3.5.1.9.2.3.

3.5.2.4.7 **Printing.** - Printing shall be done by either offset, lithograph or letterpress method, and shall be of equal quality to first-class commercial work. Copy may be type-set, varityped, or type-written with a standard typewriter. In general, type-set copy is preferred with varityped or type copy as second choice. The style of composition to be used, however, shall be governed by the quantity of manuals to be produced, the relative costs of the several methods and the availability of material prepared for earlier manuals. The contractor shall specify the method of composition to be used when manuscripts or sample copies are submitted for approval. The bureau or agency concerned may request data from the contractor to substantiate the method of composition chosen if deemed desirable.

3.5.2.4.7.1 **Arrangement.** - The text may be arranged in the form of either two vertical columns or a single wide column. The two-column arrangement shown on figures 4 and 7 is preferred; the single column arrangement is shown on figure 8. Right-hand margins shall not necessarily have lines flush at right, but care shall be taken to prepare a generally uniform margin. The size of the page shall be 8-1/2 by 11 inches. Text shall be reproduced on both sides of pages.

3.5.2.5 **Paper.** - The paper for photolithographic reproduction shall be preferably 25 by 38-60/500-basis litho-finish; for letterpress 25 by 38-70/500-basis dull-finish enamel stock.

3.5.2.6 **Covers.** - Covers for manuals less than 1/2 inch thick (less cover) shall be of the bellows fold type and of a black fabrioid material. Covers for manuals over 1/2 inch in thickness shall be made of semiflexible board covered with a black fabrioid material, weight 8-1/2 to 7-1/2 ounces per square yard (finished cloth). The covers shall be imprinted in gold, silver or aluminum color with the information shown on figure 1. Backbones of manuals over 1/2 inch in thickness shall be imprinted with the Navy Identification (NAVSHIPS) number (see 3.3.1) and title in brief. Covers shall overlap the top, bottom, and right-hand edges of the manual by 3/16 inch. Outside corners of the covers shall be slightly rounded.

3.5.2.7 **Binding.** - The binding shall be looseleaf using three 3/16-inch metal posts and screws, spaced on 4-1/4 inch centers. Covers for manuals 1/2 inch thick or more shall have a binding flange of corrosion-resisting metal covered with 700 quality fabrioid. On manuals containing less than 50 pages (25 sheets), split-type metallic fasteners with metallic washers may be used. All metal parts shall be of corrosion-resisting material, or shall be treated to resist corrosion. Should the addition of the parts list (see 3.5.1.9.1) to the manuals result in the final manual containing over 400 pages, the parts list shall be bound in a separate volume with appropriate reference on each volume as to the content of the other volume.

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MIL-T-15071B(SHIPS)

3.6 Type C manuals.

3.6.1 Contents. - Type C manuals shall contain the following information as applicable, presented in a logical arrangement (see figures 1 to 9, inclusive):

- (a) Title page (see figure 3).
- (b) General data (see 3.6.1.1).
- (c) Table of contents, listing all divisions and primary and secondary subdivisions (such as chapters or sections) with the corresponding page numbers.
- (d) List of illustrations and drawings, specifying titles, figure numbers and pages on which such illustrations appear.
- (e) Detailed description (see 3.6.1.2).
- (f) Installation instructions (see 3.6.1.3).
- (g) Adjustments and tests (see 3.6.1.4).
- (h) Operating instructions (see 3.6.1.5).
- (i) Maintenance (see 3.6.1.6).
- (j) Parts identification (see 3.6.1.7).
- (k) Drawings (see 3.6.1.8).

Note. - Although these requirements are directly applicable to manuals covering specific equipment, they shall be followed as closely as possible for manuals covering systems, such as engineering piping systems. When a manual covers a system or an equipment composed of several distinct units (for example, a generating set consisting of a Diesel engine, a generator, a voltage regulator, and a controller), it may be desirable to arrange the manual in major divisions, each covering one unit. If so, the major divisions may be arranged by subdivisions, each corresponding to the requirements herein.

3.6.1.1 General data. - This division shall contain data such as the following:

- (a) Safety notice (where high voltages or special hazards are involved) (see figure 9).
- (b) Component list containing:
 - Description of item.
 - Navy type designation.
 - Standard Navy stock number.
 - Dimensions.
 - Weight (with or without packing).
- (c) Input power requirements and heat dissipation.
- (d) Salient design characteristics.
- (e) Electron tube complement.
- (f) Serial number (if appropriate).

3.6.1.2 Detailed description. - This division shall contain a complete detailed description of component assemblies and accessories which comprise the complete equipment; for example, in the case of a ship's service turbine generator set, the turbine, the gear, the generator, the exciter, and the voltage regulator. Allowable clearances, temperatures or tolerances, shall be shown in tabular form.

3.6.1.3 Installation instructions. - This division shall contain methods of installation, alignment, precautions, mounting instructions, recommendations, regarding shielding, grounding or bonding.

3.6.1.4 Adjustment and tests. - This division shall contain instructions for the adjustment and test of the system and its major components upon initial installation or under other conditions such as after major overhaul where complete system readjustment may be required.

3.6.1.5 Operating instructions. - This division shall contain simple, brief and effective instructions, including normal routines and precautions to be observed in starting, operating, and shutting-down the equipment. Where operations are to be performed in specified sequence, step-by-step procedure shall be used. Operations shall be numbered in the order in which they are to be performed. Operating data which is frequently referred to in operating the equipment shall be included in this division. Tables and charts shall be used for the presentation of these instructions where varying operating conditions are encountered.

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MIL-T-15071B(SHIPS)

3.6.1.6 Maintenance. - This division shall cover all maintenance procedures and routine adjustments which should be performed periodically, as well as instructions for disassembly and replacement of worn or damaged parts. Instructions on lubrication shall be provided as applicable, preferably in chart form, and shall include the type of lubrication recommended by the manufacturer, together with specific time periods. Lubricants shall be described by Military specification numbers, where applicable and by commercial designations. Maintenance instructions shall cover the use of special tools.

3.6.1.7 Parts identification. - This division shall contain identification data covering all repair parts (parts and assemblies which are wearable or expendable during normal repair) to facilitate ready identification of parts for replacement and ordering purposes.

3.6.1.7.1 Parts list. - Parts shall be listed as follows:

- (a) Name of part.
- (b) Number required.
- (c) Actual manufacturer's name and service part number.
- (d) Standard Navy Stock Number assigned in accordance with Specification MIL-R-15137.

3.6.1.7.2 Parts illustrations. - A view of each assembly or subassembly or component parts shall be shown. Identification of illustrated parts shall be facilitated by the use of numbers which will identify all the parts in the parts list. Illustrations of the exploded type are preferable. When the use of exploded views is not practical, simple cross-sectional views may be used. The cross-sectional drawings when used for this purpose preferably shall be approved drawings or excerpts from approved drawings, and shall show both the manufacturer's drawing number and the drawing number of the bureau or agency concerned. In case no applicable approved drawing is available, cross-sectional views from manufacturer's drawings may be used.

3.6.1.8 Drawings. - This division shall contain reproductions of approved drawings, additional block diagrams, exploded views or explanatory drawings, as necessary to supplement the descriptive matter contained in the text. Wherever feasible, such diagrams, exploded views and sketches should be inserted in the text as close as possible to that portion of the text to which they apply. Diagrams of switches and relays used in the system showing the terminal numbering shall be inserted as additional drawings. The standard color codes for resistors and capacitors shall be stated, where applicable.

3.6.2 Format. -

3.6.2.1 Divisions (chapters or sections). - Division of manuals shall be chapters or sections, numbered or lettered consecutively. In general, chapters shall be the main divisions of larger manuals and sections shall be the main division of smaller manuals. Chapters shall be further divided into sections which shall be numbered or lettered consecutively within the chapter. Where chapters are used, the first page of each chapter shall be arranged as shown on figure 3.

3.6.2.2 Page identification and numbering. -

3.6.2.2.1 At the top of each left-hand page, flush with the outside margin, shall appear a briefer title of the manual. At the top of each right-hand page, flush with the outside margin, shall appear the division, chapter or section, number followed by its title. In some cases, it may be necessary to brief the title.

3.6.2.2.2 With the exception of fold-over pages and as otherwise specified herein, pages of the manuals shall be numbered consecutively in the bottom outside corner of each page, using Arabic numerals. The first page of chapter 1 or section 1 shall be page 1. All odd-numbered pages shall appear as right-hand pages. Fold-over pages shall be right-hand pages, and when they are used within the text they shall be assigned two page numbers, and the numbers shall be printed on the face of the sheet. Fold-over pages shall be arranged so that the page numbers are visible without unfolding. Fold-over arrangements are shown on figure 5.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

3.6.2.2.3 In manuals arranged for a system or equipment composed of several distinct units (see note under 3.6.1) the pages may be consecutively numbered within each chapter (or section), the first page of each chapter (or section) being page 1. In this case, the page number shall also include the chapter number. The chapter number shall appear first.

3.6.2.3 Layout treatment - The layout of the manuals shall be such as to conserve space without detracting from the usability or clarity of material presented. Blank pages and spaces shall be avoided wherever possible. Textual material shall be printed on both sides of the page. Illustrations serving no instructional function or to which no reference is made in the text shall not be used. Partial page illustrations within the text are highly desirable. Several small illustrations may be grouped to form a single page layout. Wherever possible, illustrations shall be located so that reference can be made from applicable text without turning a page. Fold-over pages, double, or triple pages will be permitted only for illustrations where this procedure is essential to insure legibility. Fold-over pages shall be used primarily in the back of the manual for the purpose of reproducing the drawings. Whenever it is desirable to include fold-over pages with the text in the front of the manual, such fold-over pages shall not be backed up with text or illustrations. All drawings which will be used for reference purposes while reading the text shall be provided with a blank section of the same size as a page at the left-hand edge of the drawing (see figure 5). This will permit the drawing to be withdrawn clear of the manual while the text is being studied. Drawings shall be reproduced on a page the same height as other pages in the manual, in order that all folds will be parallel to the bound edge of the manual.

3.6.2.4 Text -

3.6.2.4.1 Tables and charts - The use of tables and charts is desirable. Such tables and charts shall not be elaborate or complicated, and sufficient explanation shall be given to make them easily understood.

3.6.2.4.2 Reference to figures - Where reference is made to figures, the reference shall be to the figure number. The page number shall not be used except when the illustration is located more than three pages away from the reference. When reference is made to items shown on figures by index numbers, figure number and index number shall be indicated as follows: "Remove nut (7) and drive out bolt (8) (see figure 28).

3.6.2.4.3 Numbers - Numbers from one to nine, inclusive, appearing in the text for the purpose of stating quantities shall be spelled out. All other numbers shall be shown as numerals except when they are used at the beginning of a sentence, in which case they shall be spelled out and followed by the numeral in parenthesis.

3.6.2.4.4 Reference to materials - All materials required for maintenance referred to in the manual, such as lubricants, sealing materials or abrasives, shall be described by Military specification numbers where applicable.

3.6.2.4.5 Illustrations - Illustrations (including photographs, exploded views, drawings and sketches) shall be well planned and executed. They shall enable immediate and thorough comprehension of the subject.

3.6.2.4.5.1 Illustration identification - Illustrations shall be identified by figure number and a title. Identifying figure numbers and titles shall be positioned immediately beneath the illustration. Whenever reduced size reproductions of drawings are used as illustrations, the drawing number shall be shown as well as the figure number.

3.6.2.4.5.2 Photographs - Photographic illustrations shall be prepared with equipment capable of reproducing all details and shall show clearly the subject matter. Photographs shall be uniformly retouched to define shapes, accentuate details, and establish correct tone value of sufficient contrast for photolithographic reproduction.

3.6.2.4.5.3 Exploded views - Exploded views may be used for showing the component parts of a subject. Well retouched photographs in which sharp contrast is incorporated to insure distinct detailed separation of parts may also be used for this purpose. It is preferable that all parts be exploded on their functional axis.

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MIL-T-15071B(SHIPS)

3.6.2.4.5.4 Drawings. - When drawings are necessary to illustrate the description, operation, and maintenance of the equipment or system, they shall be reduced in size as necessary (see figure 5), and reproduced in black and white. Each drawing shall be identified with the drawing number of the manufacturer and the bureau or agency concerned. Drawings shall be bound into the manual as shown on figure 5 (see also 3.6.2.3). Drawings shall normally be placed in the back of the manual but they may be inserted close to the references when practicable. Care shall be taken in the preparation of drawings for reproduction in the manual to insure that when the drawings are reduced in size they shall be clear and legible.

3.6.2.4.5.5 Sketches (see figure 6). - (NOTE: This paragraph does not pertain to reduced-size reproduction of standard approved drawings nor to portions to these drawings which may be extracted and used as illustrations in a manual.)

3.6.2.4.5.5.1 The rendering of sketches (airbrushing or line rendering) shall be done with the highest possible contrast. Adjoining areas of an illustration having similar values are to be avoided. Edges of all silhouette half-tone illustrations shall be sharply defined by retouching.

3.6.2.4.5.5.2 Exploded views and cutaway views shall be drawn in perspective to appear as realistic as possible without distortion. Isometric views may be used for small parts or units which lend themselves to this method without showing noticeable distortion.

3.6.2.4.5.5.3 Except for diagrams, schematics, orthographic projections, reproductions of approved drawings, all line sketches shall be prepared with the use of shading mediums to clarify and model the form of the sketch. This rendering shall be kept as simple as possible. Fuzzy freehand lines, rendering with fine lines, and cross hatching shall be avoided. Solid black shall be used in dark areas to increase contrast and simplify the sketch. This applies to cutaway views, exploded views and cross-section views.

3.6.2.4.6 Indexing and referencing of illustrations. -

3.6.2.4.6.1 Significant features or components of illustrations shall be identified by brief applicable nomenclature with arrows. Index numbers may be used on illustrations with explanatory legend under the sketch or photo only when an extremely large amount of nomenclature is required.

3.6.2.4.6.2 In order to assure a clear definition of lines where they pass through light and dark areas, arrows (leaders) shall be drawn in black with one edge outlined in white. The arrowhead, however, shall be completely outlined in white. The thickness of arrows shall be uniform and no greater than necessary to indicate clearly the desired details.

3.6.2.4.6.3 Index references and letterings (nomenclature) shall be planned to reproduce uniformly a size not less than 10-point type. Where index numbers are used, each illustration shall be handled independently with index numbers assigned consecutively, starting with number 1.

3.6.2.4.7 Printing. - Printing shall be done by either offset, lithograph or letterpress method, and shall be of equal quality to first-class commercial work. Copy may be type-set, varityped, or typewritten with a standard typewriter. In general, type-set copy is preferred with varityped or type copy as second choice. The style of composition to be used, however, shall be governed by the quantity of manuals to be produced, the relative costs of the several methods, the availability of material prepared for earlier manuals. The contractor shall specify the method of composition to be used when manuscripts or sample copies are submitted for approval. The bureau or agency concerned may request data from the contractor to substantiate the method of composition chosen if deemed desirable.

3.6.2.4.7.1 Arrangement. - The text may be arranged in the form of either two vertical columns or a single wide column. The two-column arrangement shown on figures 4 and 7 is preferred; the single column arrangement is shown on figure 6. Right-hand margins shall not necessarily have lines flush at right, but care shall be taken to prepare a generally uniform margin. The size of the page shall be 8-1/2 by 11 inches. Text shall be reproduced on both sides of pages.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

3.6.2.5 Paper. - The paper for photolithographic reproduction shall be preferably 25 by 38-60/500-basis (Rho-finish); for letterpress 25 by 38-70/500-basis dull-finish enamel stock.

3.6.2.6 Covers. - Covers for manuals less than 1/2 inch thick (less cover) shall be of the bellows fold type and of a black fabricoid material. Covers for manuals over 1/2 inch in thickness shall be made of semirigid board covered with a black fabricoid material, weight 6-1/2 to 7-1/2 ounces per square yard (finished cloth). The covers shall be imprinted in gold, silver or aluminum color with the information shown on figure 1. Backbones of manuals over 1/2 inch in thickness shall be imprinted with the Navy identification (NAVSIPS) number (see 3.3.1) and title in brief. Covers shall overlap the top, bottom, and right-hand edges of the manual by 3/16 inch. Outside corners of covers shall be slightly rounded.

3.6.2.7 Binding. - The binding shall be looseleaf using three 3/16-inch metal posts and screws spaced on 4-1/4 inch centers. Covers for manuals 1/2 inch thick or more shall have a binding flange of corrosion-resisting metal covered with 700 quality fabricoid. On manuals containing less than 50 pages (25 sheets), split-type metallic fasteners with metallic washers may be used. All metal parts shall be of corrosion-resisting material, or shall be treated to resist corrosion. Should the addition of the parts list (see 3.6.1.7.1) to the manual result in the final manual containing over 400 pages, the parts list shall be bound in a separate volume with appropriate reference on each volume as to the content of the other volume.

3.7 Type D manuals. -

3.7.1 Contents. - Type D manuals shall consist of manufacturer's standard commercial instructions and parts lists bound together.

3.7.2 Format. -

3.7.2.1 Covers. - Covers shall be of a dark color fabricoid material. The cover shall show name and model of the equipment, manufacturer's name and address, Navy contract or order number and Navy NAVSIPS identification number. Printing shall be of a light contrasting color. Covers shall be 8-1/2 by 11 inches for all manuals of that size or smaller (see figure 1).

3.7.2.2 Binding. - The manuals and covers shall be bound either by stapling, stitching or by use of metal binding posts.

3.8 Workmanship. - The workmanship shall be of high quality comparable in text compilation, arrangement, and accuracy to high-grade commercial manuals and parts catalogs. Copy which has filled letters or is blurred will not be acceptable. The workmanship shall be satisfactory to the bureau or agency concerned.

4. QUALITY ASSURANCE PROVISIONS

4.1 The methods of approval are specified in section 3.

4.2 Inspection procedures. - For Naval purchases, the general inspection procedures shall be in accordance with General Specifications for Inspection of Material.

5. PREPARATION FOR DELIVERY

5.1 Packaging for domestic and overseas shipment. -

5.1.1 All manuals shall be packaged individually consistent with good commercial practice so as to ensure that they are kept dry and clean.

REPRODUCED AT THE NATIONAL ARCHIVES

MIL-T-15071B(SHIPS)

5.2 Packing. -

5.2.1 Equipment manuals for domestic and overseas shipment. - Two copies of the manual shall be packed within the shipping container holding the main unit of equipment.

5.2.2 Bulk manuals. -

5.2.2.1 For domestic shipment. - Manuals packaged as specified in 5.1.1 shall be packed in shipping containers suitable to method of shipment used and in conformance with good commercial practice. The gross weight of the container shall not exceed 200 pounds.

5.2.2.2 For overseas shipment. - Manuals packaged as specified in 5.1.1 shall be packed in shipping containers which are so lined as to preserve the manuals from water damage and dampness in conformance with good commercial practice. The shipping containers shall be so closed or strapped as to give additional strength necessary to prevent collapsing during shipment. The gross weight of wood boxes shall not exceed 150 pounds; of fiberboard boxes, 70 pounds.

6. NOTES

6.1 Ordering data. -

6.1.1 Procurement documents should specify the following:

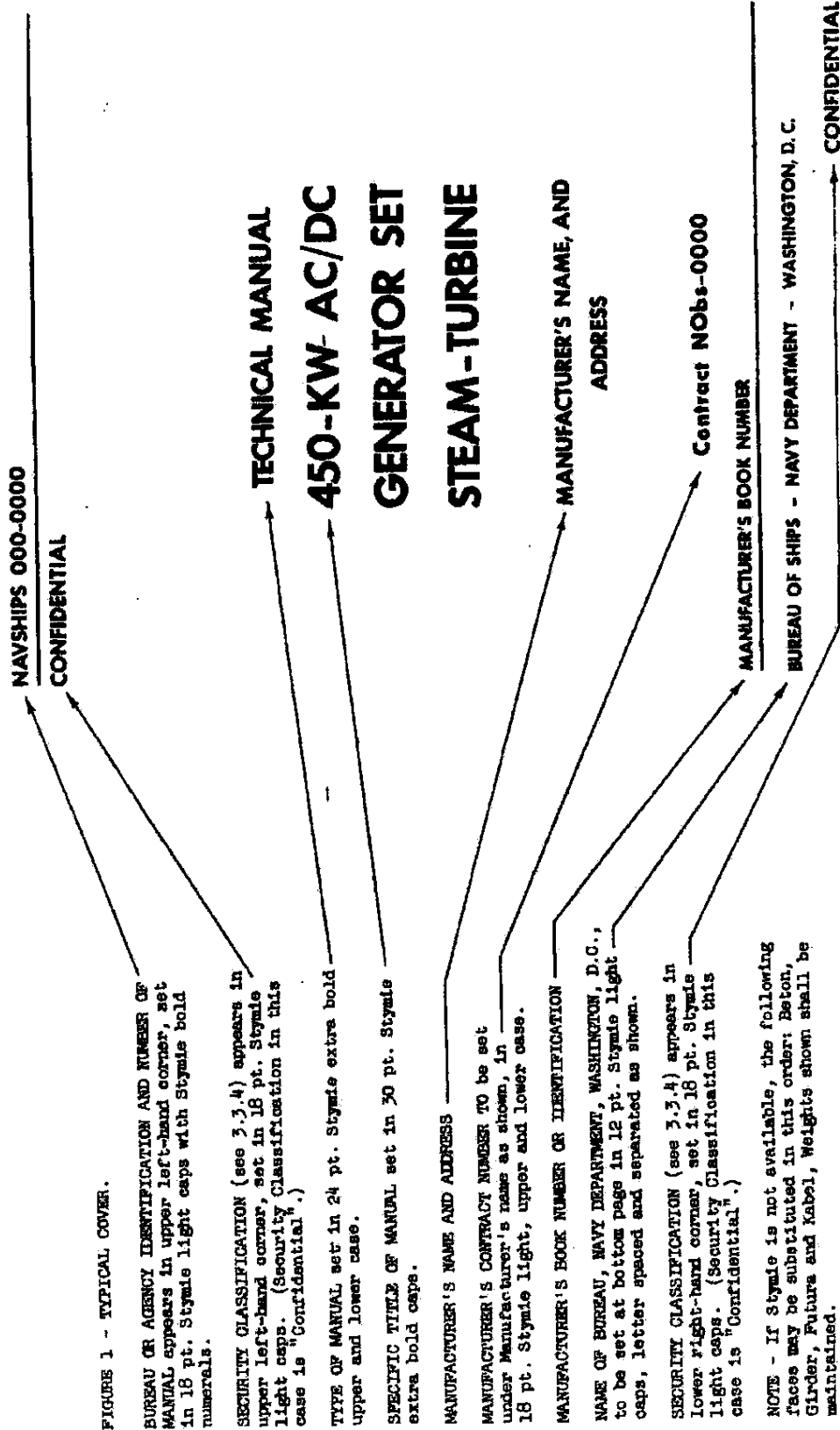
- (a) Title, number, and date of this specification.
- (b) Type required (see 1.2).
- (c) Quantity of manuals required (see 3.2).
- (d) Requirements for type A (see 3.3).
- (e) Details of special requirements for drawings, charts and illustrations, pertinent to the particular equipment, if not covered by the equipment specification.
- (f) Security classification, if required (see 3.4.4).
- (g) Whether the manuals are to be packed and marked for domestic or overseas shipment (see 5.1 and 5.2).

6.2 Figures 1 through 5b inclusive have been marked "CONFIDENTIAL" for demonstration purposes only.

Patent notice. - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

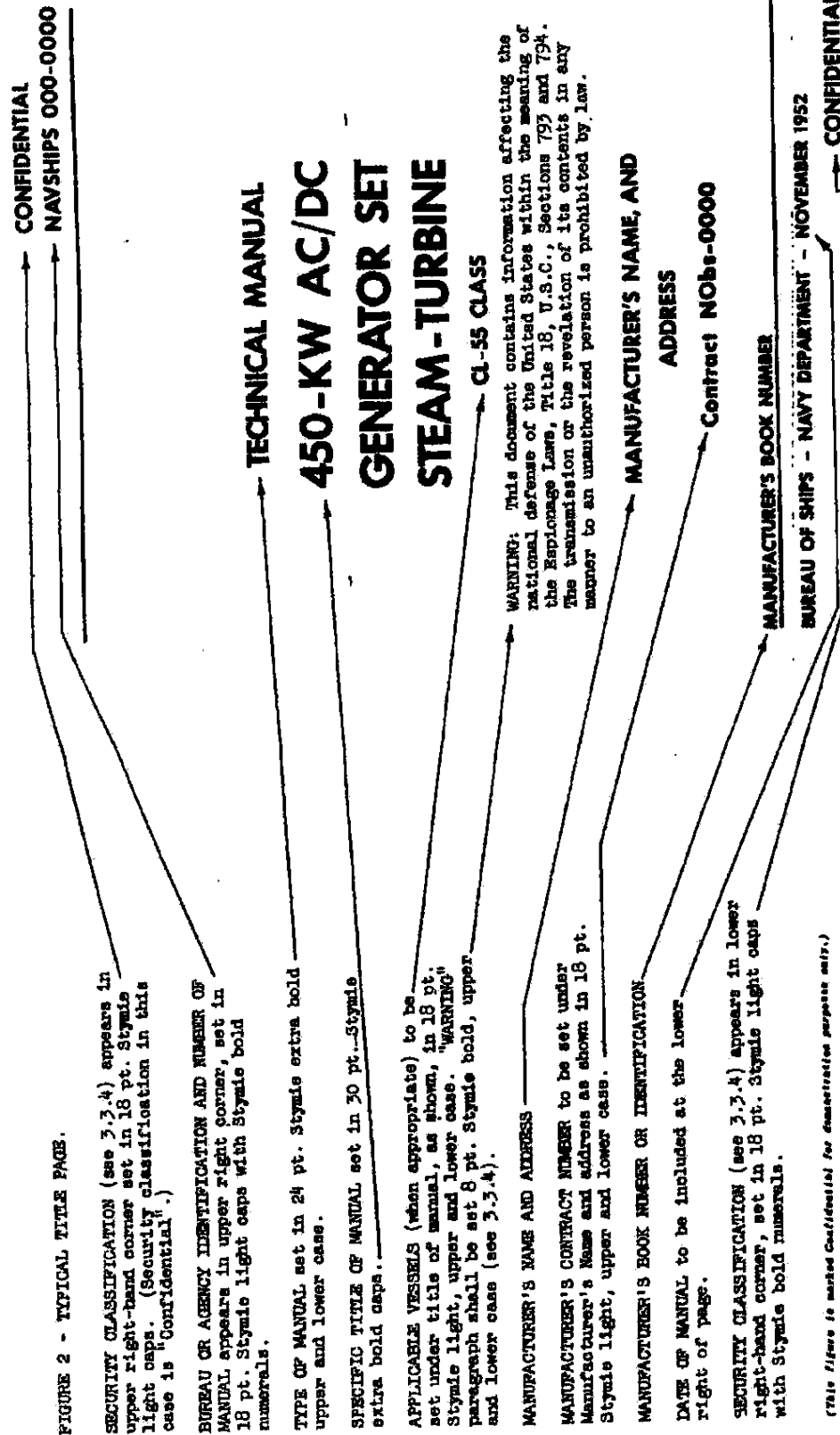
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Bureau of Ships

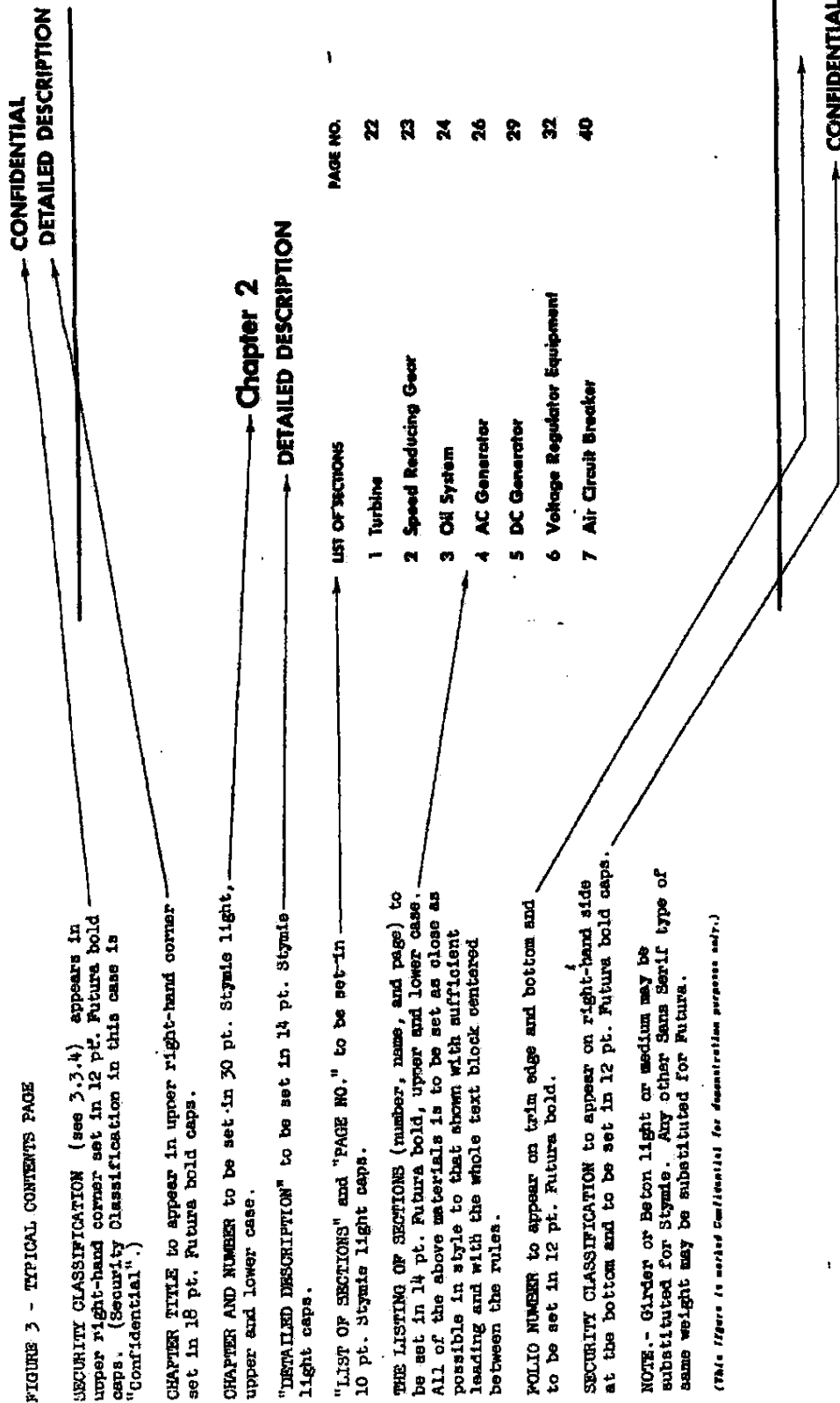
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19

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MODEL GSB-8 DIESEL ENGINE

FIGURE 5. TYPICAL GATEFOLD
OR FOLD-IN PAGES

The following two pages illustrate correct style that may be followed in gatefold pages where oversize illustrations of blueprints are to be used. Fold-over pages, double, or triple pages will be permitted only for illustrations where essential to insure legibility.

ENGINE THROTTLE CONTROL

DESCRIPTION

The engine throttle control system is made up of a series of linkages which, in direct connection with a hydraulic system, enable the operator to start and operate the engine at any required speed. (Fig. 5.) For complete understanding the following description is essential:

1. A mechanical linkage sets the limit to which fuel can be injected.
2. The engine throttle control sets the operating fuel pressure of the fuel pump.
3. A mechanical linkage from the control governor operates the control shaft which is coupled to the fuel injectors.
4. The hydraulic system, in conjunction with the linkage system, operates the control governor regulator shaft.
5. The throttle control operates the limit switch which controls the electrical circuit of the brake on the propeller shaft, just aft of the reduction gear.

The engine throttle control system is actuated by the movement of the throttle lever, or handle, of the hydraulic transmitter, which is located on the after side of the engine control box. (Fig. 1.) When the throttle lever is in the extreme out position, the hydraulic transmitter and receiver units are synchronized. (This function will be explained in detail later in this section.)

As the throttle handle is moved inward, beyond the synchronizing stage, it reaches the point where, for a few degrees of travel, it operates the air starting system (Section 20). When the air starting system is functioning, no fuel is admitted into the cylinders; however, at the instant when the throttle handle is moved farther inward and the air starting valve is released, fuel oil is

then injected into the cylinders, and the engine begins to operate under its own power. Continuing the inward movement of the throttle handle increases the amount of fuel oil which is injected into the cylinders, and thereby increases the speed and power of the engine (Section 4).

The servato shaft of the transmitter is linked with the throttle shaft which, in turn, is directly linked with the throttle lever tube. The throttle shaft is supported in two bronze bearings which are bolted to pads on the cylinder block, just below the camshaft trough. (Fig. 3.)

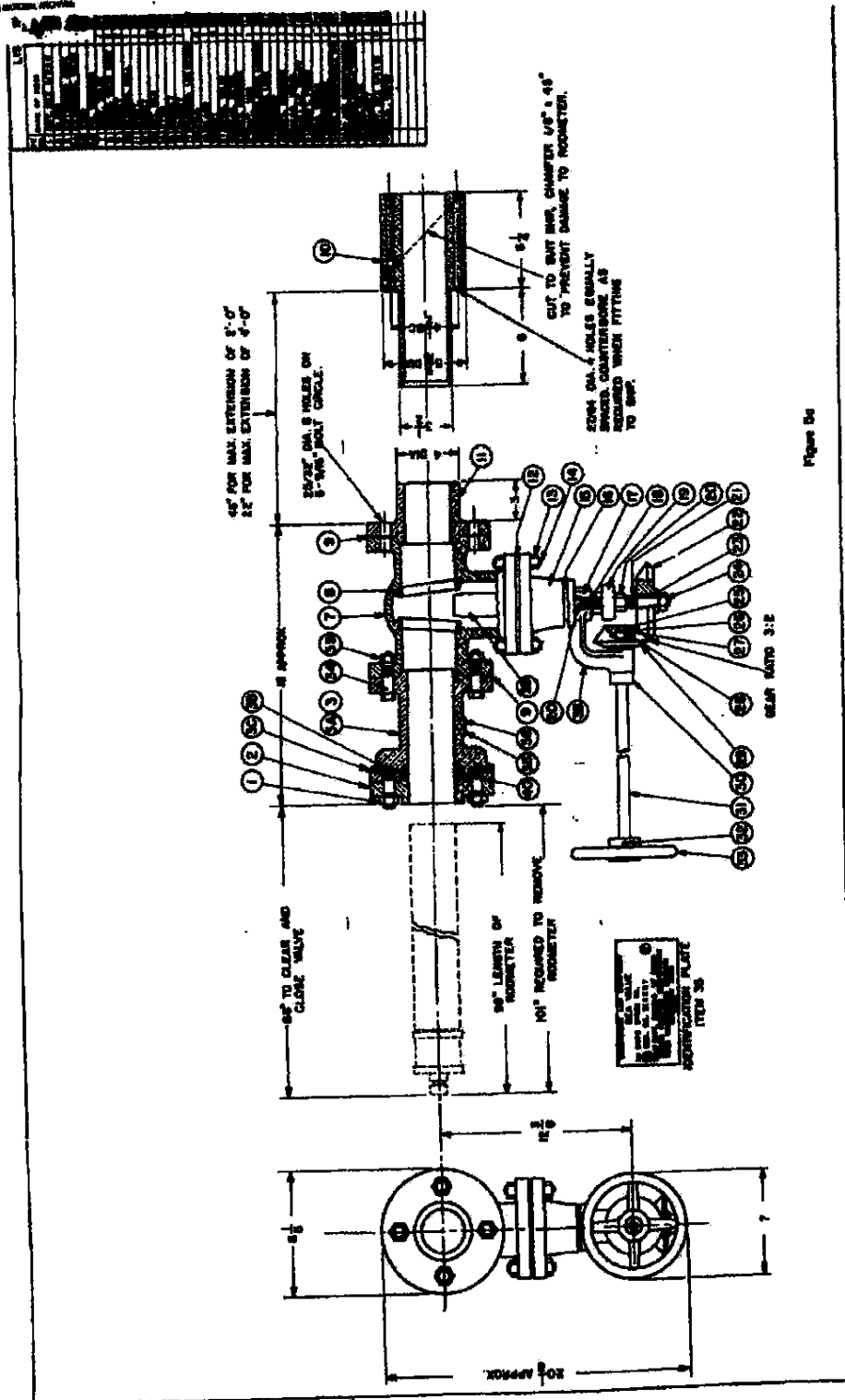
The throttle lever tube floats on the control shaft, and a lever attached to it is connected with the regulating adjusting lever of the fuel oil pump. A spring loaded piston and cylinder assembly is built into the regulating adjusting lever, and its function is to permit the throttle shaft to pass through the synchronizing and air starting stages without moving the fuel pump pressure regulating lever. This permits the regulating lever to be moved from its idling position to maximum engine load position.

A pin lever, welded to the throttle lever tube, sets a position beyond which the control lever on the control shaft cannot advance. Therefore, the control lever cannot be advanced beyond the throttle setting, and no additional fuel oil will be injected into the cylinders until the throttle is advanced farther. The control lever rides on the pin lever of the throttle lever tube, unless the automatic function of the governor tends to hold it away from the pin lever.

The two fuel injectors are synchronized and are coupled by the intermediate control shaft. The after fuel injector is coupled to the control shaft, which is supported at the opposite end by a ball bearing in a bracket attached to the camshaft gear cover.

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2

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Figure 5b. - Engine Control System.

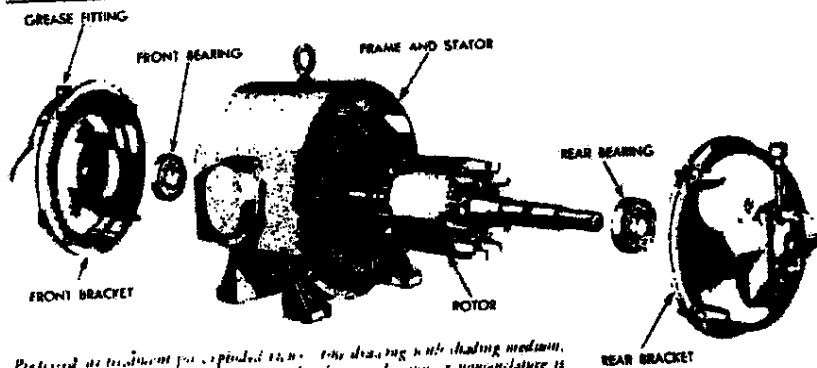
(This figure is marked confidential for demonstration purposes only.)

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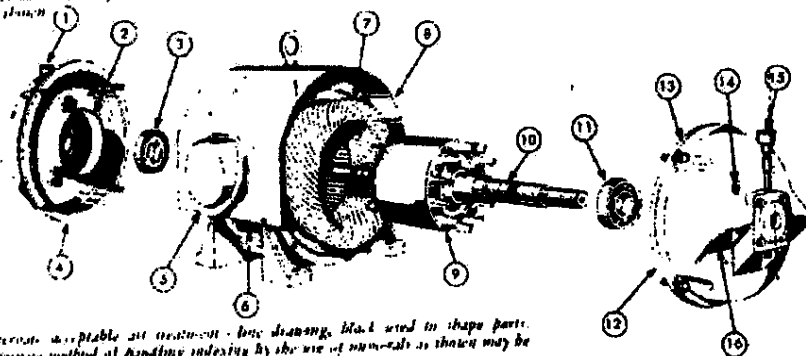
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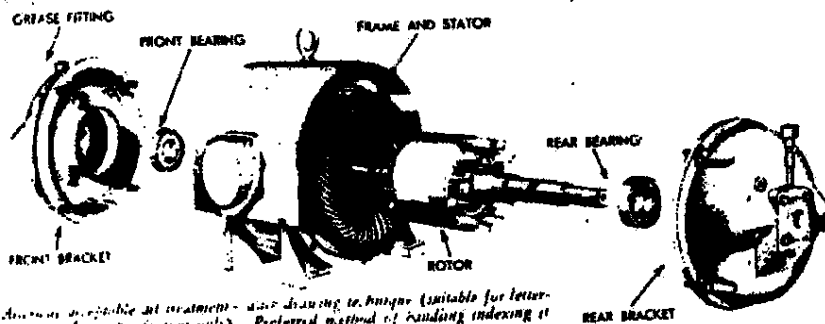
ART TREATMENT FOR EXPLODED VIEWS



Preferred treatment for exploded views - the drawing with shading medium. Preferred method of handling indexing by the use of numerals is also shown.



Alternate acceptable treatment - line drawing, black used to shape parts. Alternate method of handling indexing by the use of numerals is shown may be used if number of component parts warrants their use.



Alternate acceptable treatment - line drawing to, unique (suitable for letterpress or offset reproduction only). Preferred method of handling indexing is shown.

NOTE.—Where letterpress or offset reproduction is to be employed, well-sketched photographs, exploded as per drawing shown above will also be acceptable.

Figure 6.

26

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FIGURES 7 AND 8

These figures show approved style to be followed on manuals which are to be typewritten, varityped, or set with the electric typewriter. All copy should be prepared to allow for a 15- or 20-percent reduction in size.

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TITLE OF MANUAL

MFR'S NUMBER

PART I

DESCRIPTION OF TURBINE AND GEAR

GENERAL ARRANGEMENT

The design of the turbine and arrangement of the main parts are shown in the assembly drawing, Fig. 2. The turbine, as well as the gear and generator, is mounted on a rigid steel base as indicated in the outline, Fig. 1. The exhaust end of the turbine is carried from the base on

vertical supports which are rigid in a cross-axis direction but are flexible in an axial direction thereby allowing for axial expansion of the turbine casing under load conditions. The high-pressure end of the turbine is bolted rigidly to the gear casing.

SECTION I

DESCRIPTION OF TURBINE

The throttle valve is provided with both a hand-wheel for manual control and an emergency tripping device. The throttle valve will be tripped closed automatically by an emergency governor.

Fig. 2, is bolted to and caulked in the upper half of the high pressure head. The nozzle plate contains a series of recessed nozzles opening into ports on the high-pressure side.

ROTOR AND BUCKETS

The turbine rotor (1), Fig. 2, consisting of shaft, bucket wheels, and coupling, is machined from a solid steel forging. The coupling flange of the rotor is tapered around its outer periphery for balancing plugs.

The throttle valve is provided with both a hand-wheel for manual control and an emergency tripping device. The throttle valve will be tripped closed automatically by an emergency governor.

Buckets

The buckets of all six wheels are made of corrosion-resisting steel. They are secured to the periphery of each wheel by dovetails. The spacing of the buckets around the wheels is determined by shims at the dovetails. The shims form a part of the buckets.

A shroud-band of corrosion-resisting steel extends completely around the outer circumference of the buckets on each wheel. This band closes over the tops of the buckets and, by projecting slightly on each side of the buckets, aids in preventing steam leakage over the tops of the wheels.

The low-pressure end of the rotor carries an emergency governor assembly. The housing of the assembly is designed to receive a ratchet wrench for turning the rotor by hand. A wrench for this purpose is furnished with the unit.

NOZZLE PLATE

The cast steel first-stage nozzle plate (3),

NOZZLE DIAPHRAGMS

Nozzle diaphragms are made of steel corrosion-resisting steel nozzle partitions. The diaphragm five nozzle diaphragms are made of steel with welded corrosion-resisting steel nozzle partitions.

Mounting

Because of the high steam temperature at the inlet end of the casing, the second-stage diaphragm is supported at the centerline to allow for radial expansion.

SECOND STAGE DIAPHRAGM: The lower half of the second stage diaphragm is further positioned by the centering dowel (7) in the bottom of the casing. Crush pins (6) around the periphery of the diaphragm assist in holding both halves securely in place.

LOCATION OF DIAPHRAGMS: The other four diaphragms, which are located in the exhaust casing are mounted as shown in Fig. 3a. The cast steel first-stage nozzle plate (3), Fig. 2 is bolted to and caulked in the upper half of the high pressure head.

The first stage is drained through a valve at the bottom of the casing.

TURBINE CASING

The turbine casing consists of a steel high-pressure head (4), Fig. 2, and a steel exhaust casing.

Figure 7.

28

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MPR'S NUMBER

TITLE OF MANUAL

PART IDESCRIPTION OF TURBINE AND GEARGENERAL ARRANGEMENT

The design of the turbine and arrangement of the main parts are shown in the assembly drawing, Fig. 2. The turbine, as well as the gear and generator, is mounted on a rigid steel base as indicated in the outline, Fig. 1. The exhaust end of the turbine is carried from the base on vertical supports which are rigid in a cross-axis direction but are flexible in an axial direction thereby allowing for axial expansion of the turbine casing under load conditions. The high-pressure end of the turbine is bolted rigidly to the gear casing.

SECTION 1DESCRIPTION OF TURBINE

The throttle valve is provided with both a handwheel for manual control and an emergency tripping device. The throttle valve will be tripped closed automatically by an emergency governor.

Rotor and Buckets

The turbine rotor (1), Fig. 2, consisting of a chined from a solid steel forging. The center periphery for balancing plugs.

The throttle valve is provided with a tripping device. The throttle governor.

THIS CASE AND TYPE CASE NUMBER
DATE TYPE NUMBER 100

etc. and coupling, is mounted around its

closed automatically by an emergency

Buckets

The buckets of all six wheels are made of corrosion-resisting steel. They are secured to the periphery of each wheel by dovetails. The spacing of the buckets around the wheels is determined by skirts at the dovetails. The skirts form a part of the buckets.

A shroud-band of corrosion-resisting steel extends completely around the outer circumference of the buckets on each wheel. This band closes over the tops of the buckets and, by projecting slightly on each side of the buckets, aids in preventing steam leakage over the tops of the wheels.

The low-pressure end of the rotor carries an emergency governor assembly. The housing of the assembly is machined to receive a ratchet wrench for turning the rotor by hand. A wrench for this purpose is furnished with the units.

Nozzle Flats

The cast steel first-stage nozzle plate (3), Fig. 2, is bolted to and sealed in the upper half of the high pressure head. The nozzle plate contains a series of raised nozzles opening into ports on the high-pressure side.

Nozzle Diaphragms

The five nozzle diaphragms are made of steel with welded corrosion-resisting steel nozzle partitions. All of the diaphragms five nozzle diaphragms are made of steel with welded corrosion-resisting steel nozzle partitions.

Mounting

Because of the high steam temperature at the inlet end of the casing, the second-stage diaphragm is supported at the centerline to allow for radial expansion.

Figure 2.

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FIGURE 9 - WARNING

Voltages over 300 volts shall be measured as follows:

- (1) Deenergize the equipment. Ground terminals to be measured to discharge any capacitors connected to these terminals. (see Note F).
- (2) Connect meter to terminals to be measured using a range higher than the expected voltage.
- (3) WITHOUT TOUCHING METER OR TEST LEADS, energize the equipment and read the meter.
- (4) Deenergize the equipment. Ground the terminals connected to the meter before disconnecting meter.

NOTES:

- (A) MAKE SURE YOU ARE NOT GROUNDED whenever you are adjusting equipment or using measuring equipment.
- (B) In general, USE ONE HAND ONLY when servicing live equipment.
- (C) If test meter must be held or adjusted while voltage is applied, GROUND the case of the meter before starting measurement and DO NOT touch the live equipment or personnel working on live equipment while you are holding the meter. Some moving vane type meters should not be grounded. These should not be held during measurements.
- (D) DO NOT FORGET that high voltages MAY BE PRESENT across terminals that are normally low voltage, due to equipment breakdown. Be careful even when measuring low voltages.
- (E) DO NOT use test equipment known to be in poor condition.
- (F) High voltage high capacity capacitors should be discharged with a grounding stick with approximately 10 ohms in series with the grounded line. Where neither terminal of a capacitor is grounded. Short capacitor is grounded, short capacitor terminals to each other.